REMARKS

Reconsideration of the present application, as amended, is respectfully requested. Claims 1-38 are pending. Claims 1-5, 7-9 and 11-15 stand rejected. Claims 6, 10 and 16-24 have been withdrawn from consideration. Claims 1, 2 and 14 have been amended, and claims 25-38 have been added. As detailed below, all the claims are allowable and action to that effect is respectfully requested.

While the action sets out several bases of rejection of independent claim 1, the rejections appear to be premised on a mistaken reading of the claim. Specifically, the action erroneously refers to "time-lagged" rather than "time-tagged" with respect to the neutron source. Applicants agree that a recitation of a "time-lagged" neutron source might implicate a control system and be problematic, but Applicants respectfully suggest that the "time-tagged" neutron source as originally recited was sufficiently definite and understandable to those of skill in the art to meet the requirements of 35 U.S.C. §112. Moreover, to reinforce the clarity of the recited structure and to mitigate the possibility of future misreading, the limitations of claim 1 have been rearranged and claim 1 has been amended to explicitly recite that the control system receive a timing signal from the time-tagged neutron source.

With respect to the wherein clause of claim 5, it is respectfully suggested that, properly considered in context for what it fairly conveys to a person of ordinary skill in the art, having the ability to spatially resolve the neutron count signal so that the location of the target can be determined is an effective limitation on the neutron sensor. It sets definite boundaries on the patent protection sought and it serves to precisely define present structural attributes. See MPEP 2173.05(g) citing In re Barr, 170 USPQ 33 (CCPA 1971) and In re Venezia, 189 USPQ 149 (CCPA 1976).

Turning to the rejections based on 35 U.S.C. §102, it is believed that a proper reading of the claim reveals that the rejections are not well founded. Accordingly, the clarification of the misreading would seem to be a sufficient response to all outstanding rejections. However, in an effort to expedite prosecution of application, Applicants have the following comments on the references.

Wile the action contends that "any one of [Hahn, Chen, Buchanan, Gomberg, Schultz, Ettinger, Hewitt, Kyline, Lowery, or Skala] is <u>capable</u> of functioning in the same manner or for the same intended or desired us as the claimed invention", to the extent this statement still applies, Applicants respectfully disagree. For example, claim 1 requires that at least a portion of the stream of fast neutrons be *backscattered* from the target to the neutron sensor. Several of the asserted references (Hewitt and Chen, for example) appear to teach through transmission measurements, not backscattering.

In addition, Gomberg, Schultz, and Ettinger are primarily directed to the detection of the heavier elements such as carbon, nitrogen and oxygen, and they fail to teach the requisite time delay and the neutron count signal dependent on the amount of *hydrogenous* material present in the target. For example, Gomberg is directed to detection of scattering from elemental nuclei which have resonance in their scattering cross-sections, specifically carbon, nitrogen, oxygen, sulfur, potassium and beryllium. (see col. 6, line 58- col. 7, line 10) These atoms have nuclei of substantially greater mass than the mass of a neutron. As a result, a neutron colliding with these heavier atoms loses little of its speed and might backscattered to the detector in a single scattering event. The detection events for these interactions would therefore occur quickly. By contrast, hydrogen has a nucleus with a mass on par with the mass of a neutron, a fact with considerable significance. Scattering events with hydrogen tend to slow or "thermalize" the

neutron to a great extent, and a single scattering event with hydrogen does not result in a directly backscattered neutron. Thus, detection events for interactions with hydrogen would occur at later times relative to the interactions with the heavier elements that are the focus of Gomberg. That Gomberg attempts to measure neutrons that have been scattered by the large nuclei in the target precisely once, not those that have interacted with hydrogen, is confirmed by his description of utilizing nanosecond bursts of neutrons wherein "the detector 20 is energized in synchrony so as to detect only those neutrons in a particular burst and having a transit time equal to the interval required to travel from the source to the object 22 being interrogated and back to the detector." (col. 11, line 35-40). Accordingly, Gomberg fails to teach a neutron count signal dependent on the amount of hydrogenous material present in the target

Furthermore, Ettinger's system, assuming the action is referring to Fig. 1, appears to detect nitrogen based on the detection of gamma rays which result from bombardment of a object 16 with "thermal, or slow neutrons." (col. 4, lines 29) Ettinger explains that the sensitivity depends on "the level of thermal neutron flux within the cavity 14," and that it is "important to maintain the thermal neutron flux within the cavity at a level to optimize the neutron capture process." (col. 4, lines 57-61) Thus, Ettinger provides neutron detector 32 as a part of means 30 for adjusting the thermal neutron flux within the cavity to the desired level, where adjustment of the neutron flux is achieved by adjusting the amount of the wedge shaped moderator 42 that is in the neutron path. While means 30 is coupled to source 22 via switch 46, it does not appear that means 30 receives a timing signal from source 22 or that means 30 is capable of enabling and disabling the neutron sensor in response thereto.

The remaining references also fail to anticipate claim 1. For example, Kylin provides little detail about its neutron source, and Hahn is directed to a flow meter including a neutron

source 10 that provides "a narrow beam of continuous radiation" or "a series of fast neutron radiation pulses at a constant frequency" into the fluid flowing thereby. (col. 1, lines 51-51; col. 2, lines 13-14). Hahn then determines the flow rate of the fluid by observing the count rate at a downstream detector 14 by assuming that the downstream count rate depends primarily on mass flow rate, i.e. is independent of any timing of the neutron source. (see col. 3, lines 13-18; "[T]he count rate from the detector 14 is a function of the product of the hydrogen density (and to a less extent the carbon density) and the velocity with which the substance flows through the pipe. Thus, the count rate is related to mass flow rate.") Therefore, Hahn plainly lacks the time-tagged neutron source or the time delay as claimed. Buchanan and Skala are seen to suffer similar deficiencies.

In view of the foregoing, it is respectfully submitted that none of the cited references properly teach all the limitations of independent claim 1 as required for anticipation. Accordingly, the §102 rejections are improper and should be withdrawn.

At least because they include all the limitations of the base claim, the dependent claims of claim 1 are also allowable, obviating the need to address the remaining rejections. However, Applicants briefly note that the reliance on Ettinger for the pulse height discriminator is improper. Ettinger appears to utilize the pulse height discriminator 130 in connection with the gamma ray signal, not the signal from the neutron detector 32. Furthermore, as explained in the specification, for example pages 20-24, Applicants have found that the use of pulse height discrimination, and in particularly the use of an upper-level discriminator, provides surprisingly effective improvement in signal to noise ratios when used in conjunction with the time delay as claimed. Moreover, Applicants specifically reserve the right to challenge the combinations and other assertions in the action regarding what is purported to be obvious or well known in the art.

Claims 25-38 have been added to define additional inventions of the present application and are also allowable over the art of record. Claims 25-33 are directed to an apparatus for detecting hydrogenous material, and includes, among other things, a control system programmed to enable and disable a neutron sensor based on a timing signal to discriminate against detecting fast neutrons that are not scattered from hydrogenous materials in a target. Claims 34-37 are directed to a method of detecting hydrogenous materials and includes, among other things, enabling a neutron sensor after a time delay to discriminate against detecting fast neutrons that have not been scattered from hydrogenous materials in a target. Claim 38 depends from claim 1. All of these new claims find support throughout the specification and the claims as originally filed, and are believed to be properly considered in the present application.

Reconsideration of the present application, as amended, is respectfully requested. All pending claims are allowable, and the undersigned would welcome a telephone call to discuss any matter that would expedite prosecution of the present application.

Respectfully Submitted,

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